

Polar Gateways Arctic Circle Sunrise 2008 Conference
Barrow, Alaska, January 23-29, 2008
<http://polargateways2008.org/>

Abstract

Polar Neutron Monitors in the Study of Solar Cosmic Rays

Eduard V. Vashenyuk, Yuri V. Balabin, Boris B. Gvozdevsky
Polar Geophysical Institute of RAS (Russian Academy of Sciences), Apatity, Russia, 184209

Contact E-mail: vashenyuk@pgi.kolasc.net.ru

The neutron monitors (NMs) long since and down to the present time remain the basic means of relativistic solar cosmic rays study. The worldwide network of neutron monitors can be considered as a multidirectional cosmic ray spectrometer. The key role here is played by polar neutron monitors. Having rather narrow asymptotic cones of acceptance (viewing cones) they allow more precise determination of a direction on a source of particles and a form of pitch-angular distribution. As a characteristic example a pair of polar neutron monitors: the high-latitude station Barentsburg (at Spitsbergen archipelago) and Apatity station (at auroral zone) is considered. Despite of a rather close location, these neutron monitors have asymptotic viewing cones directed under an angle of 90 degrees to each other. The NM Barentsburg looks in the northern part of the sky, and the NM Apatity accepts radiation from the near equatorial latitudes. Thus, the polar neutron monitors can look through much of the celestial sphere.

The modeling technique of deriving of the characteristics of relativistic solar protons (RSP) from the neutron monitor network data is described. It consists of a few steps:

1. Definition of asymptotic viewing cones (taking into account not only vertical but also oblique incident on a detector particles) of the NM stations under study by the particle trajectory computations in a model magnetosphere (Tsyganenko 2001)
2. Calculation of the NM responses at variable primary solar proton flux parameters.
3. Application of a least square procedure for determining primary solar proton parameters (namely, energy spectrum, anisotropy axis direction, pitch-angle distribution) outside the magnetosphere by comparison of computed ground based detector responses with observations.

As an example, the results obtained during the 13.12.2006 GLE are considered. The RSP characteristics at the consecutive moments of time are derived and their dynamics during the event investigated. The good agreement between the derived from neutron monitors data characteristics of solar protons: energetic spectra, anisotropy direction and pitch-angular distribution with direct solar proton data obtained by spacecrafts and balloons is shown.